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Freon 21 Bearing Lubrication and Coolant System

The problem:

The existing lubrication and cooling systems for turbopump rotor bearings have been inadequate at high loads and DN values (bearing bore diameter in millimeters times the shaft speed in RPM) in a vacuum. Lubrication and cooling of high-speed rotor bearings have been attempted with lubricating oils and RP-4. However, these materials proved inadequate, especially with the bearings operated in cryogenic fluids such as liquid hydrogen. As a result of these limitations, rotors could only be run at high speeds for very short durations.

The solution:

A lubricating system was developed which uses liquid Freon 21 as a lubricant and a coolant.

How it's done:

Because Freon 21 (dichloromonofluoromethane) is an excellent high-capacity heat sink (liquid thermal conductivity at 77°F is 0.063 BTU/(hr) (ft) (°F), or equivalently at 25°C, the conductivity is 26.02×10^{-5} cal/(sec) (cm) (°C)), it was selected for use on the Mark 25 pump rotor. This rotor operates at higher DN values and with larger axial bearing preloads than typical rotors. The Mark 25 also uses a duplex pair of bearings at each of the two positions rather than the usual single bearing pair.

The Freon jets are designed so that the liquid Freon 21 expands in the bearings, removing heat by warming and by its evaporation. In operation, the gaseous Freon is

evacuated by the same vacuum pump that maintains a vacuum in the chamber in which the rotor is operating.

With this system, bearings were operated successfully at speeds up to 2.1 million DN. The duration of the tests was only limited by the drive system and by the amount of magnetic tape on data recorders.

In addition to its excellent heat conduction, Freon provides clean lubricating properties without contamination of the rotors, instrumentation, and other equipment by oil. Its potential uses include lubrication of bearings, seals, and gears in certain applications where conventional lubricants cannot operate adequately.

Note:

Requests for further information may be directed to:
Technology Utilization Officer
NASA Headquarters
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Washington, D. C. 20546
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Patent status:

NASA has decided not to apply for a patent.

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